

# LONG-TERM TRENDS IN LOBLOLLY PINE SITE PRODUCTIVITY AND STAND CHARACTERISTICS OBSERVED AT THE IMPAC RESEARCH SITE IN ALACHUA COUNTY, FLORIDA

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While nutrient availability is a dominant factor controlling leaf area development and pine productivity in the southeastern USA, few studies have explored the long-term interactions among nutrient inputs, canopy foliage production, and aboveground biomass production. In order to address these questions, the Intensive Management Practices Assessment Center (IMPAC) southern pine "growth potential" experiment was established 6 miles northeast of Gainesville, Florida.

Soils at the experimental site are sandy, siliceous, hyperthermic Ultic Alaquods. In a typical profile, the spodic horizon occurs at 10-20 in, with an argillic horizon at 35-45 in. The experiment was planted in January, 1983, and consists of factorial combinations of species (loblolly and slash pine), fertilization (repeated or none) and understory weed control (complete or none), replicated three times. This resulted in four treatment combinations: control (C), fertilizer only (F), weed control only (W), and fertilizer combined with weed control (FW). Fertilization treatments were applied annually for ages 1-11 years, with cumulative rates of elemental application over the 11 year period as follows: N (321 lb/ac), P (128), K (283), Ca (96), Mg (64), Mn (2.7), Fe (2.7), Zn (2.7), Cu (0.4), B (0.4). The fertilization treatments were curtailed from ages 12-15 yr, then were re-initiated for ages 16-18 yr, with cumulative, three-year elemental application rates of: N (650 lb/ac), P (77), K (100), Mn (1.0), Cu (0.4), Fe (2.0), Zn (0.8), B (0.4), Mo (0.008). Biomass harvests at ages 4 and 13 yr were used to develop allometric relationships between diameter and aboveground biomass components, which were combined with annual inventories to estimate aboveground biomass production. Monthly litterfall collections starting at age 6 yr were used to estimate foliage biomass production and leaf area index (LAI). Although data were collected for both loblolly and slash pine, only loblolly pine results will be presented in this paper.

In general, growth responses due to silvicultural treatments were large over the entire study period. For example, at age 18 yr the FW treatment had an exhibited site index of 82 ft (base age 25 yr), compared to 58 ft in the untreated control. Age 18 yr total inside bark stem volume accumulation in the FW, F, W and C treatments were 3672, 3269, 2994 and 1394 ft<sup>3</sup>/ac, respectively. Silvicultural treatments also tended to accelerate stand developmental processes. For example, at age 18 yr, 48 percent of stand stem volume in the FW treatment was in 9 in dbh or larger trees, compared to only 17 percent of the volume in the C

treatment. Culmination of mean annual increment (i.e., "biological rotation age") occurred at approximately age 12 yr and 250 ft<sup>3</sup>/ac/yr in the FW treatment, and age 18 yr and 78 ft<sup>3</sup> ac/yr in the C treatment. Density-related mortality was also accelerated in plots receiving silvicultural treatments. This density-related mortality became apparent at about age 16 yr in the F, W and FW treatments, but had not begun by age 18 yr in the C treatment. Self-thinning began at a Reineke stand density index (SDI) of about 360 (80 percent of maximum). Stand basal area of the F, W and FW treatments at the onset of self-thinning was 172, 159 and 192 ft<sup>2</sup>/ac, respectively.

Leaf area development was also strongly impacted by silvicultural treatments, and was particularly responsive to nutrient additions. Projected LAI at age 11 yrs (just prior to the cessation of fertilization treatments) was approximately 3.3 in the F and FW treatments, compared to 2.7 and 1.2 in the W and C treatments, respectively. During the five years without fertilization (ages 11-16 yr), LAI in the F and FW treatments declined by approximately 15 percent, remained steady in the W treatment, and continued aggrading in the C treatment. LAI of the F and FW treatments responded dramatically to refertilization at age 16 yr, increasing from 3.1 to 3.5 and 2.9 to 3.3, respectively, in the year following the retreatment.

LAI across all treatments was strongly correlated with stand basal area, but the slope of this relationship declined with stand development (age 6 yr: LAI = 0.033 \* stand BA,  $r^2$  = 0.99; 16 yr LAI = 0.019 \* stand BA,  $r^2$  = 0.98). The relationship between stem volume production and LAI (i.e. stemwood growth efficiency) was strong, but also varied with stand development. At age 7-9 yr and 10-11 yr, average growth efficiency was 37.3 and 31.9 ft<sup>3</sup> ac/yr/LAI, but by age 14-16 had declined to 16.1 ft<sup>3</sup> ac/yr/LAI.

Wood quality parameters were impacted by tree age as well as cultural treatments. Tree ring earlywood / latewood ratios declined and ring specific gravity increased from age 4 yr to 10 yr. Ring specific gravity in the W treatment increased at a greater rate than in other treatments. The transition from juvenile to mature wood (defined as the age at which ring specific gravity >= 0.5) occurred at age 7 yr in the W treatment, and at age 8 yr in the F and FW treatments. Ring specific gravity reached 0.5 by age 8 yr in the C treatment, but fluctuated around the 0.5 point at age 9 and 10 yr, while specific gravity remained well above 0.5 after age 8 yr in the F, W and FW treatments.

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